INSTRUCTION MANUAL

FOR

SUPER RAM 89

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FEATURES

1. Main Board can hold 512K bytes.

2. Expander Board can hold 512K bytes.

3. Real time clock/calender option on Expander Board.

4. Operates with Heath CP/M software and controllers or C.D.R. Systems controller and BIOS.

5. Any RAM bank can be populated with either 64K RAM or 256K RAM.

6. 2 MHZ, 4 MHZ, or 6 MHZ operation (six megahertz requires 120 ns RAM and the higher speed controller).

7. RAM may be partitioned as one or two drives, with all other floppy drives in place and used.

8. H/Z 89-90 memory can be used or not (jumper selectable).

9. No change to present CP/M software.

10. RAM drive install software supplied.

11. Selectable global memory size 1K, 8K or 16K byte.

12. Quick Installation.

13. Small Computer System Interface (SCSI) option on expander to interface hard disc controllers such as Adaptec or Xebec (up to 144 megabyte drives). Software available to control up to two drives. Updates to the SCSI software in works for true SCSI. Interconnection for multiple computer and SCSI I/O pheripherals.

SPECIFICATIONS

1. Plugs into LEFT side of H/Z 89-90.

2. Banked switched in 64K banks.

3. Uses I/O port 39H for RAM drive.
   B0H to C7H for real time clock.
   90H to AFH for SCSI interface.

4. Supports 64K or 256K dynamic RAM operation. RAM blocks may be all 64K or all 256K or blocks may be mixed.

5. Expander board plugs onto Super RAM 89 board. No other changes required to increase capacity from 512K to 1 megabyte.

6. Install software. Automatically tests for the number of installed banks.

7. Automatic install program supplied.

8. Partition capability allows warm booting on one RAM drive thus eliminating the normal floppy accesses when warm booting.

9. Power required is 0.5 AMPS with Super RAM 89 at 512K bytes and 0.55 AMPS for Super RAM 89 at 1 megabyte.

INSTALLATION

The C.D.R. Super RAM 89 main board is installed on the left hand side of the Heath Zenith 89-90 computer. Your present RAM may be left in place. If you do decide to leave it in place, locate jumper JJ3 on the C.D.R. Super RAM 89 main board and set its plug to position "B". This informs the software that the 64K RAM in the H/Z 89-90 will be used.

If you elect to install a total of 1 megabyte (Super RAM 89 plus expander), then you may well elect to remove your present H/Z 89-90 RAM in the interest of power saving, because the software only supports a maximum of 1 megabyte. In this case, place the jumper on JJ3 in position "A", and remove your 16K RAM chips. (They may be left in place but are not used by your computer.)

Locate JJ1 and JJ2 on the Super RAM 89 main board. These jumpers are placed to provide 1K byte of global memory. They may also be placed to provide 8K or 16K bytes of global memory. Note that global memory is also called common memory and is used to hold data that is common to all banks such as the Z80 stack data, etc. The following chart will indicate the proper placement of JJ1 and JJ2 for the various supported global memory sizes.

AMOUNT OF MEMORY USED FOR GLOBAL	JJ1		JJ2	
	A	B	A	B
1K	Open	X	Open	X
8K	X	Open	Open	X
16K	X	Open	X	Open

Unless you are installing CP/M 3.0, we recommend that the 1K global setting be used as this provides the largest amount of storage when using the Super RAM 89 as a super fast set of disk drives. (See your CP/M 3.0 software manual for recommended global memory size.)

Mechanically the installation procedure is simply one of removing the H/Z 89-90 CPU card. Locating the Z80 CPU, removing it, placing the Z80 CPU on the Super RAM 89 board, plugging the 40 Pin connecter into the empty CPU Z80 socket, and plugging the Super RAM 89 into the Pins of P501 and P507 located on the H/Z 89-90 CPU card.

The flying lead on the shielded cable is intended to be connected to ground. One of the hold down bracket mounting screws for left hand cards is convenient and is recommended for this purpose.

In you have been into and out of your computer very much, the above procedure is fairly simple and straightforward. HOWEVER, the first time can be a real pain - mental (did I leave something out - put something in wrong? - etc. - etc.) and physical (where did that smoke come from?).

So we are including some illustrations to help out.

The illustrations show which screws to remove (and finally) replace). (Do not turn on power if any parts are left over.) Which connectors to remove and more importantly, how to replace them in the correct orientation.

There are four connectors on the main CPU board. The one in the lower right corner is frequently overlooked. Check that none of your I/O boards on the right side of your computer are replaced with one pin off. This causes a lot of hate and dissention.

The two nylon connectors on the left hand side of the board, if not replaced correctly, have also caused smoke and its attendant mental depression - USE CARE!

An excellent idea is to have your Heath Zenith manual handy for quick checks on your work. As you are probably aware, these manuals are regarded as perhaps the best in the world. Use them whenever in doubt.

With the Super RAM 89 installed, check for the normal dual "beeps" and H prompt. If you did not hear them, turn power off immediately and check the seating of all connectors including the Z80 socket connector. The usual cause is forgetting to connect the small connector just to the left of your I/O board support bracket.

With the H prompt on the screen, boot up one of your CP/M system discs and pip to it the "INSRAM" program supplied by C.D.R.

NOTICE NOTICE NOTICE

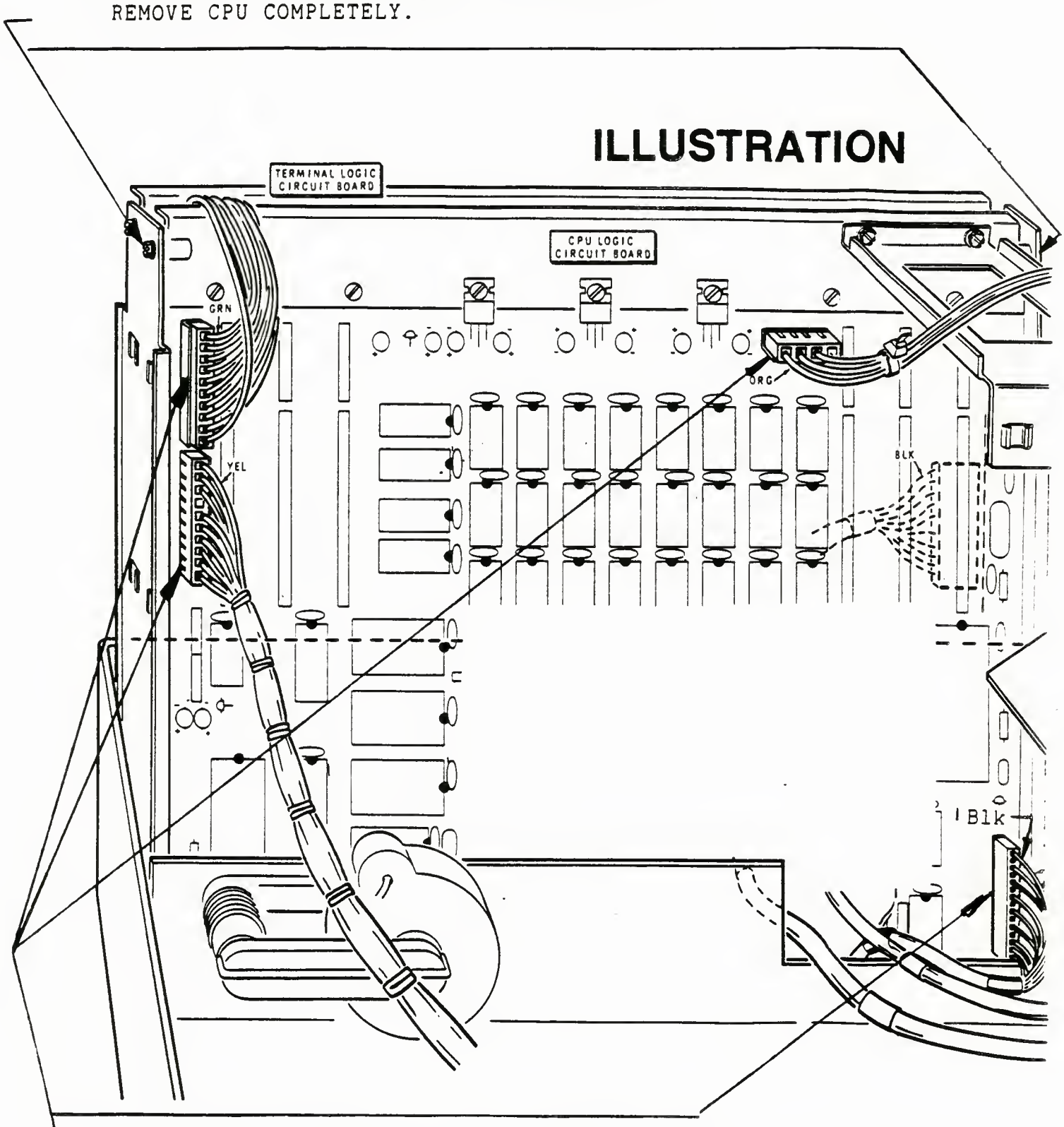
The Super RAM 89 uses a 1K minimum global area. This implies that a CP/M system of 63K bytes or less must be used for your system.

Use "CPMSIZE" from C.D.R. OR "MOVECPM" from Heath/Zenith to construct your 63K byte system.

Then boot up this sytem and run the program "INSRAM" and answer the questions on the screen.

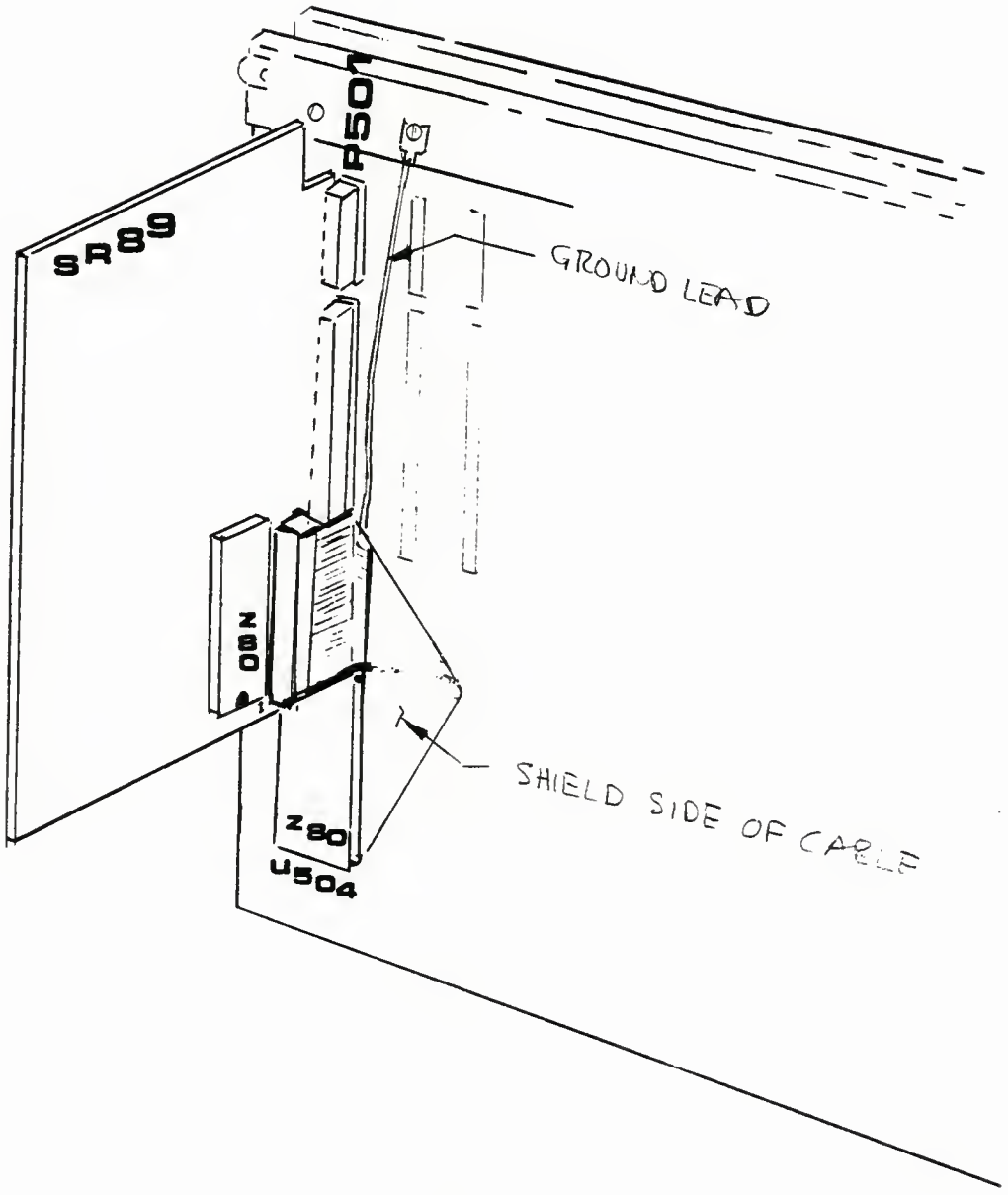
The software section of the manual will guide you further.

REMOVE THESE SCREWS, THEN REMOVE ALL VISABLE CONNECTORS.
LIFT CPU BOARD, REMOVE RIGHT SIDE BOARDS, LIFT CPU
CARD ENOUGH TO REMOVE LOWER RIGHT CONNECTOR.
REMOVE CPU COMPLETELY.



REPLACE THESE CONNECTORS. PAY CLOSE ATTENTION TO WIRE COLOR CODE.
WATCH THAT ALL PINS ARE ENGAGED!!

REMOVAL AND REPLACEMENT ILLUSTRATION FOR SUPERRAM 89.



SUPERRAM 89 INSTALLATION

THEORY OF OPERATION

The basic operation of Super RAM 89 (SR 89) stems from the design decision to move the H/Z 89-90 Z80 from its socket to the a socket on the Super RAM 89 board. This allowed all of the Z80 signals (address, data and control) to be accessed by the circuitry on the SR 89 board.

The SR 89 is based upon a bank switching technique. This requires the use of an I/O port which was selected to be 3A HEX. The required signals to produce the decoded I/O signal 3A HEX are fed to U19. This chip also provides decoding for the SR 89 expansion board real time clock and SCSI hard disc controller interface. The Z80 output signals are fed down to the H/Z 89-90 board via a six inch cable connected to J1 on the SR 89 board.

When the expansion board is plugged onto the SR 89 board, this cable is plugged into J1 on the (SR 89 EX) expansion board instead of onto the SR 89 board.

The I/O 3A HEX signal is used in conjunction with data bus bits D0, D1, D2 and D3 to select one of sixteen banks. This selection is performed by the interconnection of U20 and U22. These chips also determine the amount of RAM reserved for global use via Pin 8 at U20.

U20 Pin 11 informs the SR 89 if main CPU board RAM is to be used via JJ3.

JJ1 and JJ2 code the output of U18 to inform U20 of the amount of global memory.

U21 is a dynamic RAM controller and when provided Refresh (Pin 28 of the Z80), and MRQ (pin 19 of the Z80) will provide *CAS (Column Address Select), *RAS (Row Address Select), *WRITE and Multiplexed RAM addresses MA0 through MA8, for the RAM banks.

U17 is used to prevent *CAS to the RAM banks when a program wishes to use the H/Z 89-90 ROMs for booting drives or running in the monitor.

Undershoot damping resistors are used in series with all signals for U21 and U17 to the RAM banks.

The RAS signal for banks 2 and 3 along with all other output signals from the RAM controller are fed to a connector J3. This connector is used to provide drive to the SR 89 expander RAM. Data pins from all RAM are fed to the Z80 data pins and to connector J2. This connector also has data developed by the RAM on the SR 89 expander board and data developed by the real time clock and SCSI interface circuitry located on the SR 89 expander board.

SUPER RAM 89 EXPANSION BOARD
THEORY OF OPERATION

The Super RAM 89 expansion board (SR 89 EX) contains two RAM blocks. Either all 256K or all 64K RAM may occupy a block. The RAM blocks are U1 through U8 and U9 through U16. Addresses, control signals and power are fed to the RAM blocks via P3. Data is fed to the RAM blocks via P2.

When the SR 89 EX is plugged onto the SR 89, the connector to the H/Z 89/90 CPU is plugged into P1. This connector also provides addresses to the real time clock at U22. Note that minimal software is provided for this option. Integration of the clock into your system is not supplied.

This clock is selected at I/O addresses A0 HEX through B7 HEX via Pin 9 of P2.

Basic clock timing is provided by the crystal X1 and associated resistor capacitor networks comprised of R1. R2. C18 and C19.

The clock runs off 5 volts connected to Pin 24 through diode D2. When the H/Z 89 is powered down. the clock uses the lithium battery B1 or optionally, an external battery connected to the connection holes under the battery location (observe polarity). The external battery is divided down by R9 and R8 to provide 3 volts to the clock chip when the computer power is off. The circuit has been used for 3 years with a 9 volt transistor battery at considerable less cost than a lithium battery (1982 prices). C.D.R. Systems supplies a lithium battery when the clock option is ordered.

The PAL at U20 is used to provide decoding and selection of the SCSI interface comprised of U17. U19. U20, U21, U22, U23 and resistors R2 through R18.

The SCSI I/O decode is provided from P2 Pin 10 and is set at 90 through 97 HEX with the DMA controller addressed at C0 through CF HEX. The SCSI ID generator, U19 is addressed at 88 through 8B HEX.

An external hard disc controller ZEBEC or Adaptec is connected to J5.

Operation requires the C.D.R. Systems hard disc software package. (Available separately.) Complete circuit operation is described in the SCSI option instruction manual.

The following is an explanation of the INSRAM.COM file. INSRAM.COM is used to add one or two RAM Drives to your current version of CP/M 2.2. When the RAM Drive(s) are installed, PIP.COM or some other file copy program can be used to pass desired files from the floppy or hard disk drives to the RAM Drives. Read this section and the CHECK THE FOLLOWING section of this manual before running the RAM 89 system. You may also want to check-out the RAM in the system before installing the RAM Drive(s). Read the RAM CHECK-OUT section for details on how to check the RAM.

With INSRAM.COM there are a wide variety of ways to create and use the high speed RAM Drives with your system.

INSRAM.COM can create one or two RAM Drives. The created RAM Drive(s) can be located starting anywhere within the range of A: to O: in CP/M 2.2. When the RAM Drive(s) are specified to start with drive A:, all floppy and hard disk drives get moved down in logical drive letters so that all drives are still accessable. Also warm booting (control-C) will happen through the First RAM Drive (VERY FAST), with no floppy disk accesses needed. This means that once the desired files are in RAM Drive(s), the floppy drives don't have to be accessed and can be turned off until they are needed.

INSRAM.COM can create drives of varying sizes. INSRAM.COM will automatically test for how much RAM is available for RAM Drives, and if two RAM Drives are created, the first drive can be set to any 63K boundary size, with the second drive taking the rest of the available space, or all of the available space can be set to one BIG RAM Drive.

INSRAM.COM can optionally create a set of two RAM Drive start-up files ARAM.COM and SRAM.COM that retain the installed INSRAM characteristics so that all of the INSRAM questions do not have to be answered when bringing up the RAM Drive(s).

SRAM.COM brings up the RAM Drives in a pre-set form and asks only the question of whether to erase the RAM Drive(s) directory or not. When the RAM Drive(s) are brought up the first time after the computer is turned on, the RAM is in an unknown state. Erasing the directory, clears the RAM and sets the RAM Drive(s) with a clean slate with no files. Resetting the computer with the Shift-Reset keys, when the RAM Drive(s) were in use, usually does not destroy the files in the RAM Drive(s), and if the NOT erase option is selected when the RAM Drives are reentered with the same RAM Drive configuration, the files that were there prior to the Reset should still be there.

ARAM.COM is the Auto install version of SRAM.COM. It automatically checks if the RAM Drive(s) have valid files and sets a clean directory if they don't. This file is great to use as the first instruction in a submit file. ARAM.COM will continue the submit only if the RAM Drive(s) were not previously installed since the last computer turn-on. With this capability, the computer can be set from the time a floppy or hard disk is booted, to automatically bring up the RAM Drive(s), pass preset files to the drives, and even start the execution of a program, so that whoever is using the computer can immediately derive the benefit of the speed and power of the RAM Drive(s) without having to type in a lot of commands first.

There are a lot of ways to set your RAM Drive system with INSRAM.COM. We suggest installing the RAM Drive(s) in a lot of different ways so that the most comfortable method of using RAM 89 on your particular applications can be found.

The following is a description of the Messages and Questions encountered in INSRAM.COM. WARNING: First make a 63k bootable disk. INSRAM.COM uses the last 1k of memory for bank switching. (see CHECK THE FOLLOWING for details on how to do this).

1. Execute the INSRAM.COM file by typing INSRAM . The initial RAM 89 hardware up to the date 7/26/85 uses I/O port 38H to switch banks of memory. This version works fine with the Heath/Zenith H37 and H17 system, and also with the C.D.R. double density 8 inch and 5.25 inch controller system, but the MMS controller also uses this port. So the current RAM 89 packages come set to port 39H or 3AH. The version of INSRAM.COM on this disk checks for where the bank switch port is located and will work on any of the RAM 89 configurations of hardware. This is also true for the RAMTST.COM RAM tester program on this disk (see the RAM CHECK-OUT section for details on this program). All future CP/M software updates will include this capabillity.

The first message on the screen is the entry message. It shows the current version number and asks for you to press any key to continue. INSRAM will exit with no effect on your current system if it is exited at this point with control-C (holding down the CTRL key and pressing the letter C).

2. Once a key is pressed (not control-C), INSRAM will check for RAM banks and display the number of logical 63K banks found to be available for RAM Drive(s). If you have installed both Board 1 and the Expansion Board and have populated both boards fully with 256k chips, then 15 logical banks will be available, since bank 0 is needed for the standard CP/M RAM, and the maximum addressing is for 16 banks including the CP/M RAM.

In this mode, the internal RAM will not add to the RAM capacity and can be left in (JJ3 in A) or taken out (JJ3 in B) at your discretion. If there is less than the full Megabyte of RAM installed, then the standard 64k RAM in the computer can still be useful, and with JJ3 in the B position, INSRAM will recognize the added 64k of memory.

3. INSRAM will ask the question:

"Do you want to make Auto Install files (Y or N) [N]?"

If you press the (Y) key, then INSRAM will create the ARAM.COM and SRAM.COM files on the booted drive that will match the RAM Drive configuration created when INSRAM is completed. The created files can be renamed and used under the new names so that a number of configurations of RAM Drive starters can reside on the same floppy or hard disk. If the (N) key or (RETURN) is pressed, no files will be created.

4. INSRAM will then ask the question:

"Do you desire to split RAM into two Drives (Y or N) [N] ?"

This question will appear only if 256K or more is installed in RAM 89. If you press the (Y) key, then INSRAM will create TWO logical RAM Drives out of the available banks of RAM. If you press the (N) key or (RETURN), then INSRAM will create ONE logical RAM Drive out of the available RAM. Some canned programs expect to run with two drives on the system. With the ability to make two logical RAM Drives, those type of programs can be run completely in RAM Drives with one drive as the program disk, and one drive as the data disk. When there are two RAM Drives, they will always be next to each other in drive letters.

5. INSRAM will then ask the question:

"Do you want to Warm Boot from RAM (Y or N) [N] ?"

If you press the (Y) key, then the RAM Drive(s) will start at drive A: with all other drives moved down in drive letters. As an example, suppose you have the FDC-880H double density disk controller with 4 drives on it, and the H17 hard sector controller with 3 drives on it. When you boot the system, there are 7 drives available as A: through G:. If two RAM Drives are created and set to be warm bootable, the RAM Drives are A: and B: and the floppy drives become C: through I:. All drives prior to RAM Drive will still be available. Warm boots (control-C) will happen through RAM Drive A: and be very fast.

6. INSRAM will then ask the question:

"Enter Drive to be Ram Drive ?" for one RAM Drive or
"Enter Drive to be first Drive ?"

This question will appear only if the (N) key or (RETURN) were pressed when the Warm Boot question was asked (number 5. above). When the RAM is set to be warm bootable, the RAM Drive(s) are forced to start at A:.

Pressing one of the letters B through O will set the RAM Drive(s) to start at that drive letter. If the RAM Drive(s) are set to start where it is possible to be a physical drive (floppy or hard disk), the RAM Drive(s) will move the physical drive and succeeding drives down in drive letters automatically.

7. If there are to be two RAM Drives (from question 4.), the below information will be displayed. Otherwise INSRAM will continue with question 10. The below information is provided by INSRAM so that you can select the size of the first RAM Drive. The second RAM Drive will take up the remaining available space.

THERE IS A TOTAL OF nnnK AVAILABLE FOR RAM DRIVE

A	62K
B	124K
.	.
.	.
.	.
l	nnnK

Enter the letter for the Size of Drive x Wanted ?

The number of posssible sizes of the first drive will vary depending upon the size of RAM available. Drive x will be the drive letter that the first RAM drive will be.

If the letter selected for the size of the first drive is the same size as the maximum RAM available, INSRAM will ask the next question:

"You have selected all RAM in Drive Y is this correct (Y or N)?"

If the (Y) key is pressed, then the first RAM Drive will have all of the RAM and the second RAM Drive will not be created. If the (N) key is pressed, INSRAM will allow a reentry of the desired size of the first drive.

8. INSRAM will then ask the question:

"Erase Ram Directory (Y or N) [N] ?"

If the computer has just been turned on or if you want to clear all information out of the RAM Drive(s), then press the (Y) key. This will erase the RAM Drive(s) directory. If the RAM Drive(s) have already been in use, the files are still available if the (N) key or (RETURN) is pressed. This feature is so that if a program hung for some reason and the computer had to be reset, when the RAM Drives are brought back with the same parameters as before, the files will still be there.

After this question is answered, INSRAM will install the RAM Drive(s), create the ARAM.COM and SRAM.COM files if they were specified, display the size of the RAM Drive(s) that were created, and return control to CP/M with the RAM configuration installed.

The RAM Drive(s) will now act like standard drives on the system. Files can be transfered back and forth with PIP.COM or some other file transfer program.

CHECK THE FOLLOWING

1. Before running INSRAM be sure that you have previously made a 63K version of CP/M 2.2 to run the system. RAM 89 uses the very last 1K in memory as a global for going between RAM banks, and for holding itself. If you are using the FDC-880H, CPMSIZE.COM must be used to create a 63K image PUTCPMxx.COM file.

If you are using the H37 and/or H17 controller, use the following instructions to create a bootable 63K image. The information is in the H/Z manuals, but it can still be tricky:

First create a 63K image in memory with the MOVCPMnn.COM file

MOVCPM17 63 or for the H37 MOVCPM37 63

Then without resetting the computer, SYSGEN the new image

SYSGEN

WARNING when SYSGEN asks for the SOURCE Drive, DO NOT enter a drive letter. Press only the (RETURN) key. SYSGEN will then use the image in memory created by MOVCPM instead of what is on a specific drive as it's SYSGEN source. The destination must be already bootable with a BIOS image. When you boot the newly SYSGENed disk, it should show 63K in the boot message. Check that your system parameters are correct, with the CONFIGUR.COM file. Using SYSGEN with this 63K disk will create other 63K system disks.

2. Programs that do not go through standard CP/M BDOS calls, but directly reference specific locations in a particular BIOS may not function correctly depending upon how they try to locate the information in the BIOS.

3. The Heath/Zenith H/Z89 version of Super Calc (the one with the hole in it) does not copy correctly between disk drives of any type in a standard computer configuration, with the standard PIP.COM program. The RAM 89 package will not change this problem. There are however a number of public domain transfer programs written by people who had to address this problem just to pass SC.COM between floppy disk types. These programs should also work with the RAM 89 Package. The H/Z version of Supercalc also does not know about extra memory either. We suggest using Super Calc 2, since it will allow larger spead sheets and allow them to be partially in the TPA and partially in files. This version could then take full advantage of RAM 89.

4. XMODEM.COM for transfering of files by modem looks into the BIOS to communicate with the system. In the documentation for XMODEM, there is a number that is used for I/O routine access. This number if set to 0 will look for a spot in the BIOS. The number should be set to the I/O routine address in the BIOS prior to using RAM 89. XMODEM can then be used when in RAM 89. Otherwise XMODEM must be used while not in RAM Drives. We will address this problem specifically soon. The results will be on our bulletin board, Ph. (619)560-8929 password SDHUG, along with future updates of RAM 89 software.

5. CONFIGUR.COM or I/OMOD.COM should be run while not in RAM Drives. RAM Drives attach onto what ever configuration that is present.

6. If INSRAM.COM is executed and the computer hangs-up, or while using the RAM Drive(s) strange characters show on the console or programs stop working correctly, there could be a problem with the RAM in the system. Run the RAMTST.COM program (details in RAM CHECK-OUT section) to see if the RAM and RAM accessing is having problems. Also check the RAM 89 board connections and cable connections. A weak connection can show all types of problems.

If there are any problems in the installation or in the use of the RAM 89 system, or if there are any questions about the system, contact C.D.R. Systems Inc. between the hours of 1:00 and 3:00 Pacific time, at (619)560-1272.

Also remember that the latest software updates are available to you through our Bulletin Board ph. (619)560-8929. As a C.D.R. customer, use the special password SDHUG when going into the bulletin board's CP/M. The password will allow access to the C.D.R. directory, which holds update files for some of the C.D.R. products.

RAM CHECK-OUT

The RAM 89 system has a total of 8 banks of RAM possible, with 2 banks of RAM on Board 1 and two banks of RAM on the expansion board (Board 2). Each bank of RAM holds 8 RAM chips. The type of chips that can be used in a bank of RAM are the 256k by 1 bit chips (41256) or the 64k by 1 chips (4164). We recommend that the 256k chips are used since they hold 4 times the amount of storage and they don't cost much more than the 64k chips. When RAM 89 is acquired with the RAM already installed, the RAM should be valid since the RAM is tested at the factory after being installed on the RAM 89 Board(s). The RAMTST.COM file supplied on the distribution disk can be used to re-check the RAM and to check RAM that is bought separately.

RAMTST.COM performs the following tasks:

1. Checks that the RAM 89 system can access the different RAM bank areas.

2. Checks that the 64k banks that are specified to have RAM in them do not interfere with each other.

3. Checks that the RAM in each of the specified 64k banks are valid.

4. Provides a running account of what it is testing and sends error messages to the console when errors are encountered.

RAMTST.COM Does not test Bank 0 since that is where the operating system resides and it uses the operating system in communicating with the console. If Bank 0 has bad RAM, it may be hard to even get to the RAMTST program since CP/M may not be executable. If this occurs. use the original 64k in the computer (installed with JJ3 in B position) which will then have all of the RAM 89 banks external to the operating system RAM, and then try to bring up CP/M and use RAMTST.COM.

When RAMTST.COM is completed, Reset the computer and reboot from scratch. since RAMTST will corrupt the operating system in Bank 0 if it encounters errors in the other banks of memory.

To use the RAMTST.COM program, first make sure that if RAM Drive(s) were in use that all files on the RAM Drive(s) were backed up. RAMTST.COM will clear the RAM Drive(s) completely, leaving all RAM Drive banks in an unused state. Also check that all hardware connections are correct for RAM 89. One problem that can show as erroneous memory problems is in the location and size of the screws holding up the fly-back transformer in the left hand side of the computer, near where the RAM 89-to-CPU cable is. Sometimes those screws are too long and can press against the cable hard enough to make contact with the signal lines. If this is the case, turn the computer off and cut the screws down to a smaller size, so as not to interfere with the cable.

Execute the RAM Test from the drive holding the tester by typing:

```
RAMTST
```

The RAMTST.COM program will print a header message with a brief description of what it will do, then send the message:

```
Press any letter to continue, (CTRL-C) to EXIT
```

If you do not wish to run the RAM Test program, Warm or cold boot the system, otherwise press the (RETURN) key to continue with the RAM Test program.

RAMTST.COM will now ask some questions to verify what RAM is to be tested:

```
Is the Main Ram Installed and Jumper Set (Y or N) [N] ?
```

This first question is checking whether the original 64k on the main computer board is being used. When jumper JJ3 at the top of the RAM 89 board 1 is closest to the Main CPU board (position B), the original 64k is in use. In this state, the original 64k becomes Bank 0, and all of the RAM 89 RAM (up to 15 banks) is used for RAM Drives, and tested with RAMTST.COM. If the original 64k is not in use, the first 64k logical bank of RAM 89 will become Bank 0, with all other banks moved down one bank. Answering this question correctly is important since RAMTST will perform tests based upon where it expects logical Bank 1 to be.

Once the location of logical Bank 0 is determined, RAMTST.COM will ask for what type of RAM it should be looking for in each PHYSICAL bank of RAM 89. There are 2 physical banks (rows) of RAM on Board 1 and 2 physical banks on Board 2.

Physical Bank 1 is on Board 1 in sockets U1 to U8 (the row closest to the edge of Board 1).

Physical Bank 2 is on Board 1 in sockets U9 to U16 (the row on the inside).

Physical Bank 3 is on Board 2 (expansion board) in sockets U1 to U8 (the row closest to the edge).

Physical Bank 4 is on Board 2 (expansion board) in sockets U9 to U16 (the row on the inside).

Each physical Bank has a possible 4 logical 64k banks of RAM in it. depending on whether the 256k chips or the 64k chips or no RAM at all are used in that physical bank. The last 64k logical bank of physical Bank 4 will not be used if the original CPU 64k is used (maximum of 16 logical banks).

RAMTST.COM will ask the question:

Enter the response that is the contents of physical bank 1

A = No Ram installed
B = 64k Ram installed
C = 256k Ram installed

This question will be asked for each of the 4 physical banks possible in the RAM 89 system. The above information is so that the RAMTST program can accurately compare what it sees as available RAM with the type of RAM that was actually installed in each physical bank.

Once the above questions are answered, RAMTST.COM will start the testing process.

RAMTST will display on the console:

Testing ability to switch physical banks

At this point the Bank switching port is tested extensively to determine whether the different banks of RAM can be switched in and out of the direct access area separately, without cross-talk. If this test fails. there is a strong possibillity that one of the chips that control the RAM 89 memory accessing has failed, or is making a weak connection in it's socket. Also if Board 2 is in use. check that it is pressed firmly together with Board 1.

If the test was successful, the word PASSED will show on the console. Otherwise the word ERROR will show.

After a successful physical bank switch test. RAMTST will display on the console:

Testing abillity to switch within a 256k Ram

Now RAMTST will check that it can address the 4 logical RAM banks within a physical bank separately, without cross talk. If this test fails. it is also a sign that one of the chips that control the RAM addressing may have failed, or is making a weak connection.

If the test was successful, the word PASSED will show on the console. If there are no 256k physical banks specified, or the only one specified happens to also hold Bank 0, RAMTST will state that it CANNOT RUN this test section and continue. If there were any problems found in running the test, the word ERROR will show.

After a successful logical bank switch test, RAMTST will map the available logical banks in order starting from Bank 1, and display on the console:

```
Testing for BAD DATA bits

Logical bank   01        PASS 1
               02
               03
                .
                .
                .
               15
```

RAMTST will now perform a 0's 1's A's and 5's test on each logical bank of RAM. It will perform this test twice for each bank. While it is performing the test it will update the console as to what Test Pass it is on, and which bank it is testing. If a bank of RAM can pass this test, RAMTST will show PASS 1, then PASS 2, then PASSED for that bank. If the RAM in that bank fails, RAMTST will show ERROR and display what RAM chip(s) it found the error(s) in. Example:

```
1U3  2U13
```

Where 1U3 stands for RAM 89 Board 1, location U3 (this address is silk screened on the RAM board), and 2U13 stands for RAM 89 Board 2, location U13. Notice that both boards 1 and 2 have locations U1 through U16.

If only one or two chips show as bad in a bank of RAM, check for bent pins on the chip(s), and maybe exchange the chip(s) with chip(s) in other locations and retest the RAM to verify that the chip(s) are definitely at fault. Replace the bad chips if necessary with good chips.

If all chips in a bank show as bad, check all board connections to be certain of good contact, and make sure that the secifications as to where the physical RAM chips were located at the beginning of this test were correct. If that does not prove to be the problem, move the (bad) chips to another bank and see if the errors move with them.

WARNING: a problem that is hard to test for is the possibility of having 64k chips mixed in with 256k chips in the same bank of RAM. This problem will produce strange results with the RAM test. If both 64k and 256k chips are to be used in the RAM 89 system, it does not matter where the different banks of RAM are located, as long as within a physical bank the chips are all of the same type.

Once the test for bad data bits is completed, RAMTST will ask the following question:

Basic tests complete, want extensive test Y or N ?

At this point, through the Basic Tests, the RAM has been tested for switching between physical banks, and logical banks, and data bits have been tested for the ability to change from 0 to 1 and back. In most cases if the RAM passed this far it should be valid. In a few cases more extensive tests are needed. If errors have already been encountered, now is the time to take disks out of floppies, turn off the computer and start to check-out and fix the possible problems. Otherwise either end the RAM testing or continue with the extensive tests.

The Extensive Test checks for correct addressing within the 64k logical blocks, and for cross-talk between bits located in different addresses in memory.

RAMTST will display:

Testing Address to RAM A0 thru A7 PASSED

This test checks the RAM addressing within 256 byte segments, thus verifying that each RAM address is accessed separately. If this test passes with no errors the word PASSED (as shown above) will be displayed. Otherwise the word ERRORS will show. The cause of this type of problem usually is not in the RAM chips themselves, but in the addressing chips or in bad connections with connectors. Check all board connections to be certain of good contact.

Once the testing of internal addressing passes, RAMTST will display:

```
Testing Internal Ram Addressing
     Logical Bank        01              PASSED
     Logical Bank        02              PASSED
        .     .          .               .
        .     .          .               .
     Logical Bank        nn              PASSED

     Testing Complete No Errors Found
     Press any Key to Exit to "H:" Prompt
```

If no errors are found, the No Errors Found message will show. Otherwise the ERRORS message will show for the logical bank(s) that have errors, and ERRORS will show after the Testing Complete message. The internal RAM testing checks that the data within a logical block does not have any cross talk between data bits when using different addresses. The problem if it occurs for individual RAM chips is usually due to a faulty RAM chip or a bad connection between that chip and it's chip socket. If it shows for a whole bank of RAM, then the problem is probably due to the addressing control chips or a bad connection on the board. Check that the RAM 89 board connections are making good contact, and check that all of the chips on Board 1 of RAM 89 are making good contact (without bent under pins) with their respective sockets.

If all of the tests pass, then the RAM 89 system hardware is physically functional. Other problems that could affect the RAM 89 system are power supply failures or dropouts (check that at least the H37 power supply upgrade was made on your computer), or dirty power from the electric company (ask us about what Movistors can do), or problems in the software installation.

If problems do occur, please contact C.D.R. Systems Inc. for technical assistance, at 7210 Clairemont Mesa Bl., San Diego, CA. 92111, or call (619)560-1272 between the hours of 1:00 and 3:00 Pacific time.

Also remember that the latest software updates are available to you through our Bulletin Board ph. (619)560-8929. As a C.D.R. customer, use the special password SDHUG when going into the bulletin board's CP/M. The password will allow access to the CDR directory, which holds update files for some of the C.D.R. products.

APPLICATION NOTE I FOR RAM 89 CP/M SOFTWARE V.1.5 AND ABOVE

This application note is for those wishing to construct an auto load routine to automatically transfer your programs from floppy to the RAM Drive(s) during the Boot process. (Prior versions V.1.3 and V.1.4 may be updated for a $15.00 charge or down loaded from the C.D.R. bulletin Board (619)560-8929. Password: SDHUG

Procedure:

1. Make a submit file that will perform the desired tasks.

A. Make a Bootable disk that is set to know about your particular computer and printer configuration.

B. Place on that disk SUBMIT.COM, XSUB.COM, PIP.COM, your favorite editor (i.e. WORDSTAR, or PIE, or ...), and the programs you wish to transfer to RAM Drives. The programs you wish to transfer can be on disk(s) in other drive(s).

C. Use your editor to create a text file with an extent of SUB. i.e.: TESTFILE.SUB. TESTFILE can be any name up to 8 characters long. This text file will hold the commands that you would normally have to type in to transfer files from normal drives to RAM drive(s), with the first command in that file as ARAM.

D. If the commands that are entered have to be issued within a program, then the file XSUB.COM must be used. XSUB must be issued after ARAM if it is to be used.

E. Below is an example of a submit file to switch to a single RAM Drive set to be drive A:, and copy all of the files from the booted floppy (moved to drive B:) and the second floppy (moved to drive C:) to the RAM Drive.

TESTFILE.SUB holds the following 3 command lines. No extra blank lines should be present.

```
ARAM
B:PIP A:=B:*.*
PIP  A:=C:*.*
```

The booted drive should have at least ARAM.COM PIP.COM, SUBMIT.COM and the submit file TESTFILE.SUB for this function to work. Also ARAM.COM should have been set for only one RAM Drive when created by INSRAM.COM.

F. Below is an example of a submit file to switch to dual RAM Drives set to be drive A: and B:, and copy all of the files from the booted floppy (moved to drive C:) to RAM Drive A:, and the second floppy (moved to drive D:) to the RAM Drive B:.

TESTFILE.SUB holds the following 3 command lines. No extra blank lines should be present.

```
ARAM
C:PIP A:=C:*.*
PIP  B:=D:*.*
```

The booted drive should have at least ARAM.COM PIP.COM, SUBMIT.COM and the submit file TESTFILE.SUB for this function to work. Also ARAM.COM should have been split into two RAM drives when created by INSRAM.COM.

G. Below is the same example as example F:, but with XSUB used to allow PIP.COM to be run as an example of how a file can be used with internal commands.

TESTFILE.SUB holds the following 5 command lines. No extra blank lines should be present.

```
ARAM
C:XSUB
C:PIP
A:=C:*.*
B:=D:*.*
```

The booted drive should have at least ARAM.COM, XSUB.COM, PIP.COM, SUBMIT.COM and the submit file TESTFILE.SUB for this function to work. Also ARAM.COM should have been split into two RAM drives when created by INSRAM.COM.

2. Once the submit file is created, the next step is to get INSRAM.COM to create the ARAM.COM file in the desired fashion.

A. Execute the INSRAM.COM file to create RAM Drive(s).

INSRAM

B. Answer all of the questions as desired, being sure to answer Y to the AUTO INSTALL ? and the WARM BOOT ? questions. This procedure will create ARAM.COM and SRAM.COM and place them on the booted disk. It will also create RAM Drives which is not wanted yet.

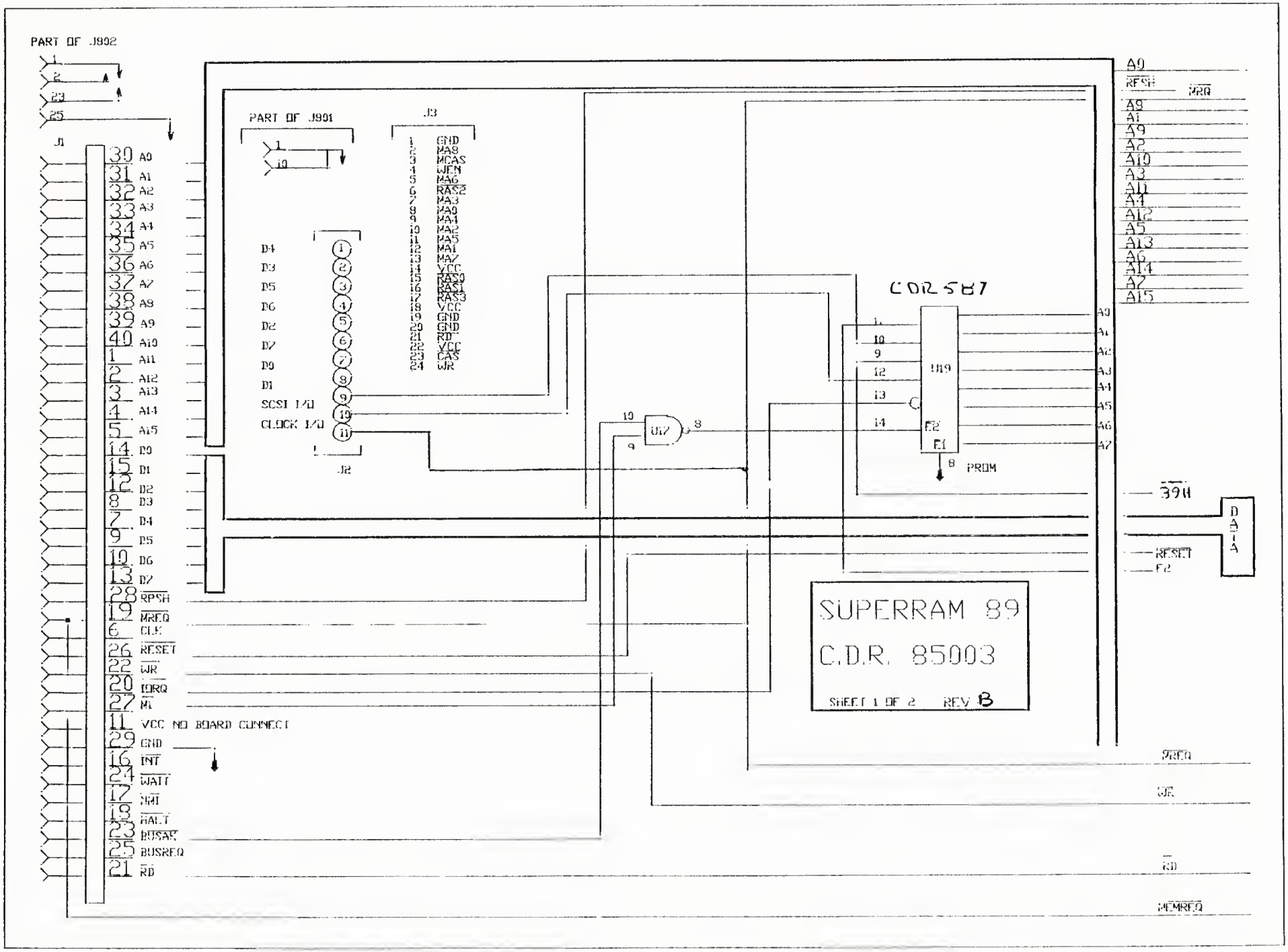
3. Once the ARAM.COM file has been created, the RAM Drive memory must be zeroed out so that ARAM.COM won't think that RAM Drives are already available, forcing it to discontinue a submit. Currently the only sure way to clean out the RAM Drive(s) is to pull out your floppy disks and turn the computer completely off, then on again. The standard Reset does not clear out the RAM Drives and ARAM will stop a submit file it is in, if RAM Drives are present. This is so that RAM Drives can be undisturbed after a Reset even if rebooting on an auto boot disk.

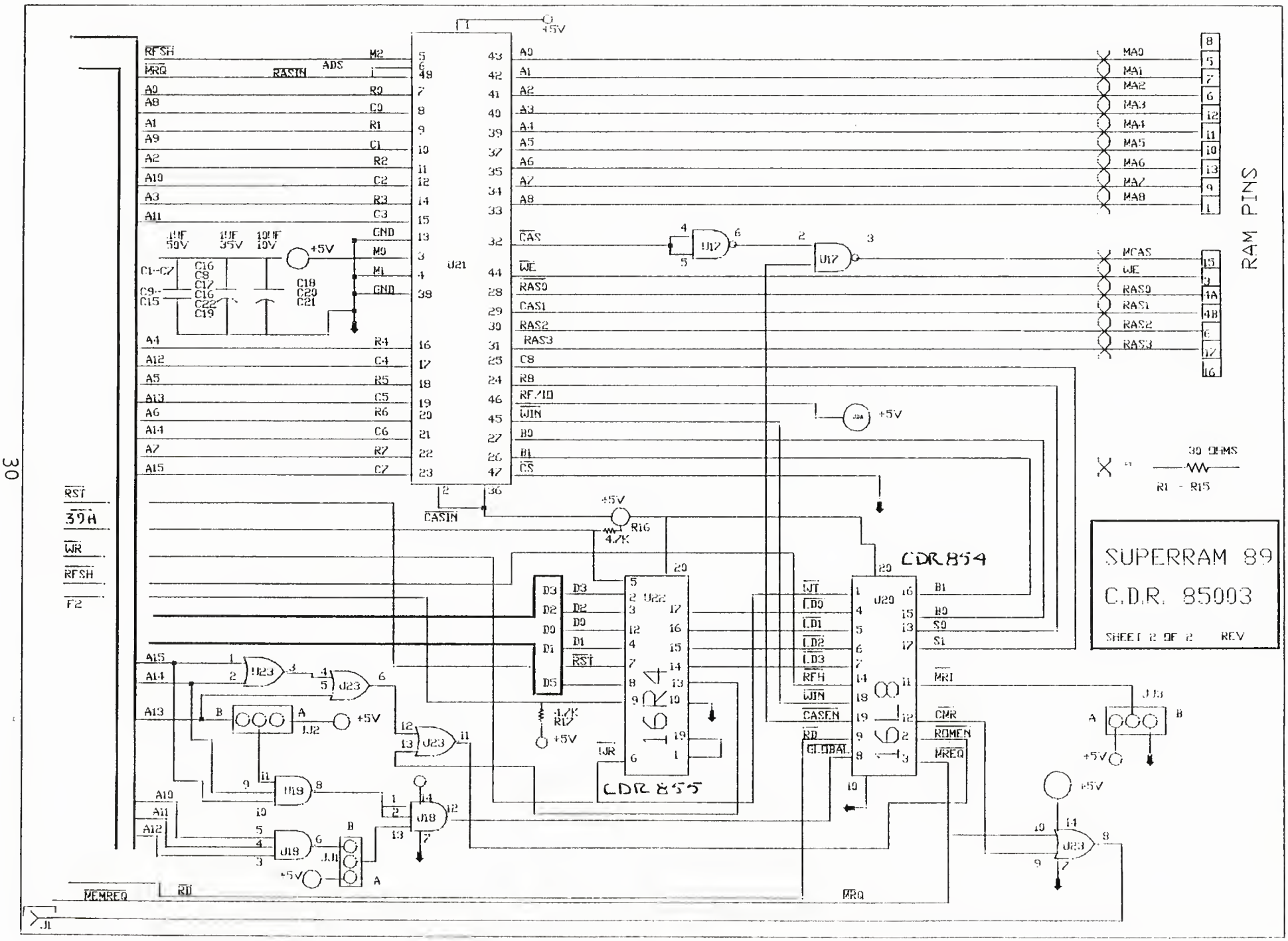
4. From now on whenever the computer is first turned on, the command: SUBMIT TESTFILE execute the commands in test file to go into RAM Drive(s) and pass down floppy disk data to the drive(s). To set autoboot mode place the SUBMIT TESTFILE command in the auto command line of the operating system.

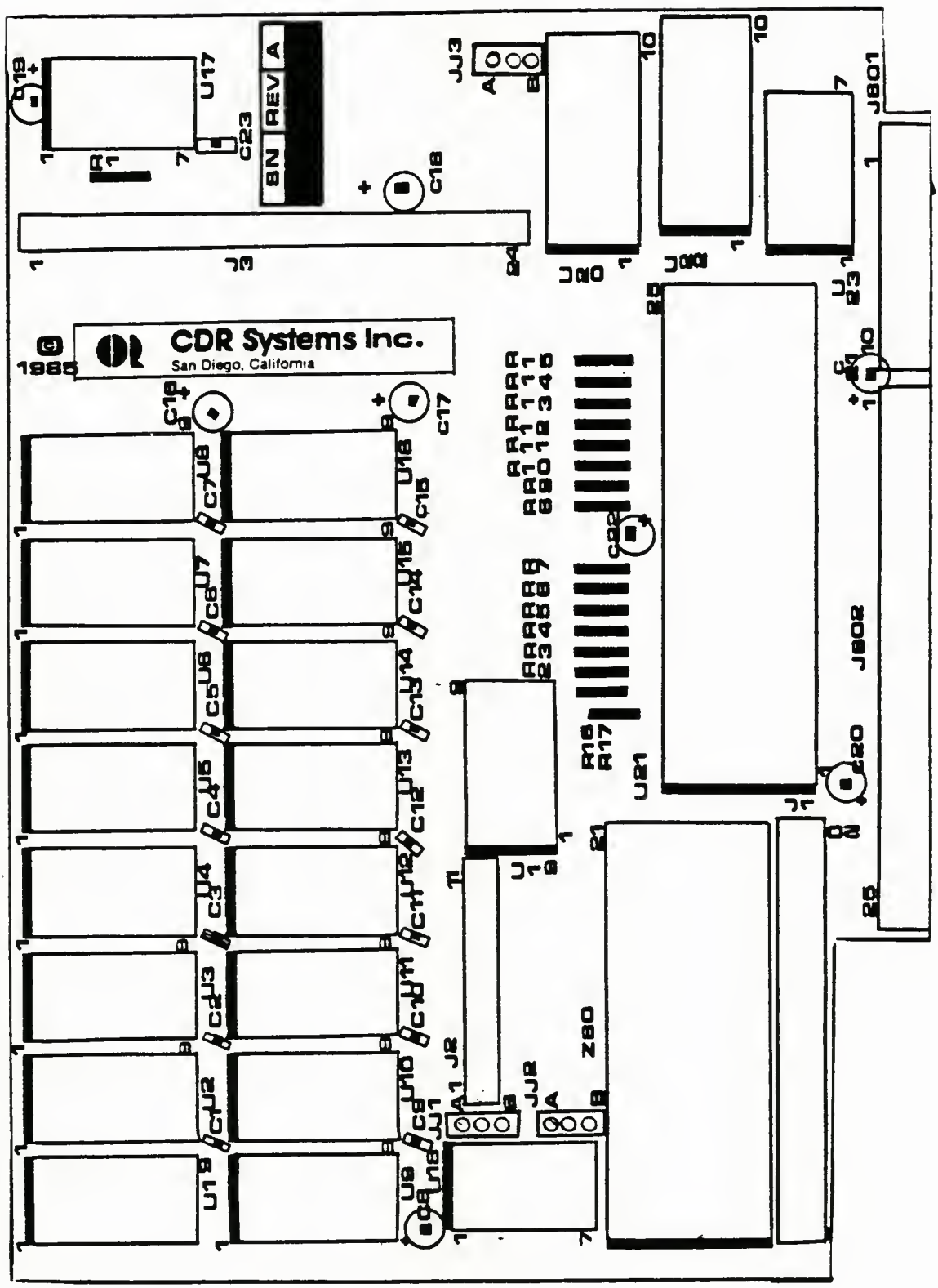
To do this under the Heath CP/M Operating System, execute the CONFIGUR.COM program, answer No to the STANDARD CONFIGURATION question. and place the command in the AUTOMATIC PROGRAM CONTROL SUB-MENU, with the A option to RUN AUTOMATIC COMMAND LINE ON COLD BOOT set TRUE. and exit making permanent changes.(see page 106 of H/Z CP/M manual)

To do this under CDR CP/M Operating System, execute the I/OMOD.COM program. select C on the main menu to do the AUTOBOOT COMMAND LINE. select A for COMMAND ON COLD BOOT ONLY, place the SUBMIT TESTFILE command as the message, exit to the MAIN MENU and make a PERMANENT CHANGE TO THE SYSTEM TRACKS.

When the disk boots from scratch, it will automatically go into RAM Drive(s). and if the computer was off since the last time RAM Drive(s) were initiated, the files specified to be passed down in the submit file will be loaded.


PART OF J992
J1
PART OF J991
J3
J2
SCSI I/O
CLOCK I/O
PROM
U19
U17
SUPERRAM 89
C.D.R. 85003
SHEET 1 OF 2 REV B
VCC NO BOARD CONNECT
RESET
WR
IORQ
M1
RPSH
MREQ
CLK
INT
WAIT
NMI
HALT
BUSAK
BUSREQ
RD
MEMREQ
DATA


RAM PINS
SUPERRAM 89
C.D.R. 85003
SHEET 2 OF 2 REV
CDR854
CDR855
30 OHMS
R1 - R15
RFSH
MRQ
RASIN
ADS
CASIN
WE
CAS
RAS0
RAS1
RAS2
RAS3
WIN
RST
WR
RFSH
F2
MEMREQ
RD
MRQ
J1
U21
U22
U23
U17
U18
U19
U20
U12
U13
U14
U15
U16
R16
4.7K
R17
+5V
GND


CDR Systems Inc.
San Diego, California
1985
REV A
SN
J801
J802
Z80
JJ1
JJ2
JJ3
U17
C23
C18
C17
C19
C16
C15
C14
C13
C12
C11
C10
C9
C8
C7
C6
C5
C4
C3
C2
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
U12
U13
U14
U15
U16
U18
U21
U23
R1
R5
R6
R15
R16
R17
T1
J1
J2
J3
J4
J5
J6
J7
J8
J9
J10
J11
J12
J13
J14
J15
J16
J17
J18
J19
J20
J21
J22
J23
J24

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PARTS LIST

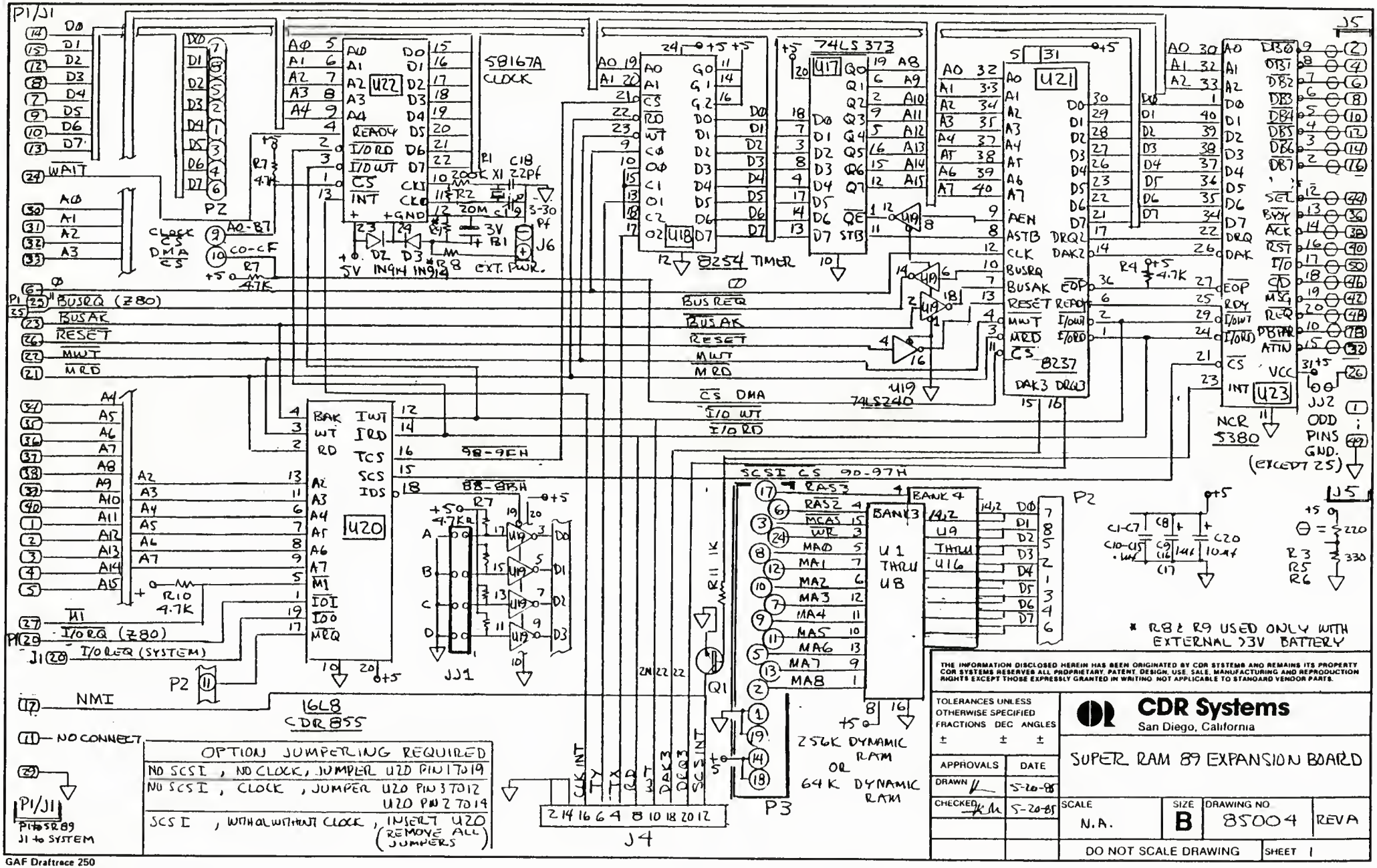
DESCRIPTION: SUPER RAM89 (RAM 1)

DWG. NO. 85003

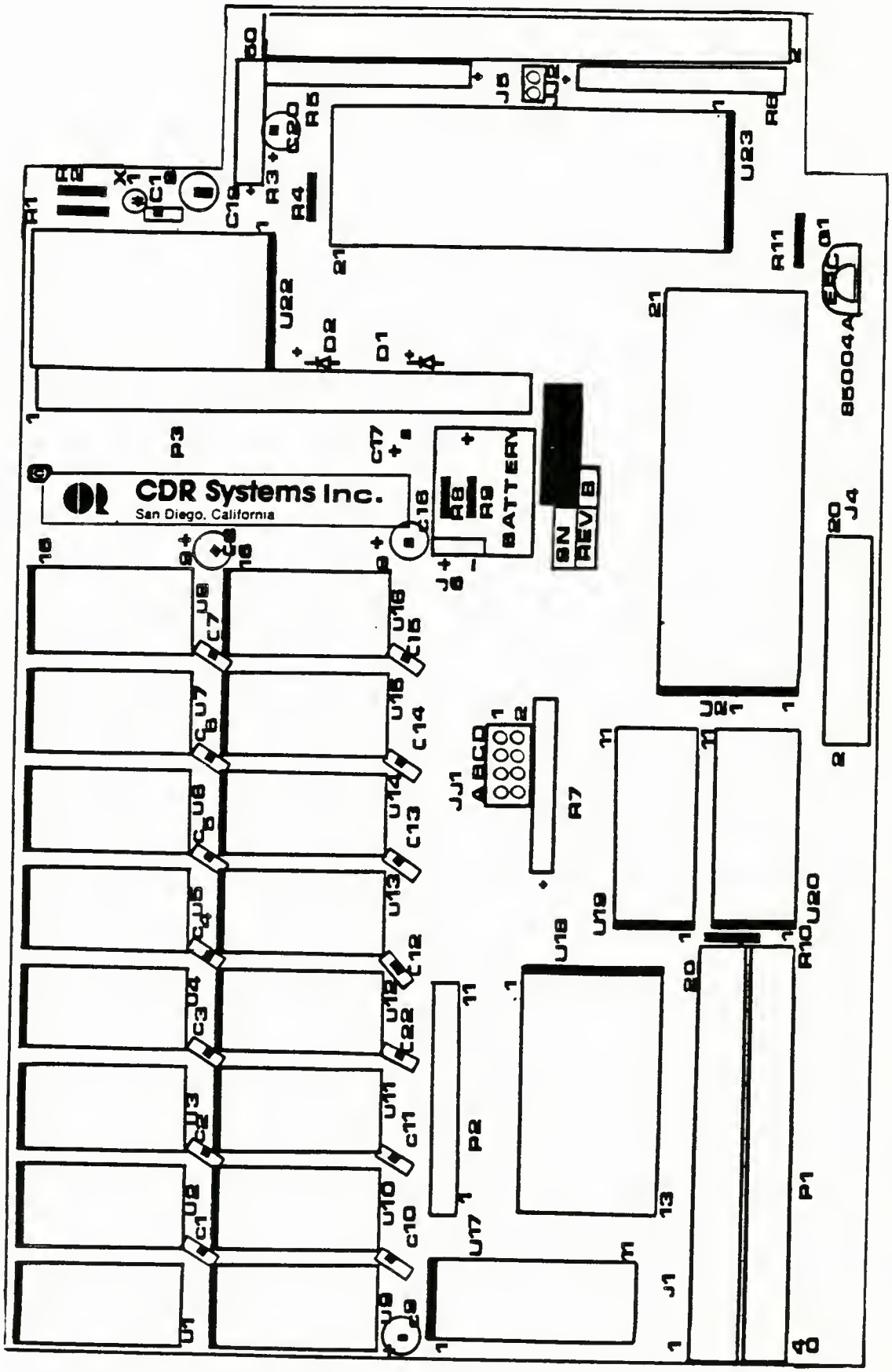
DATE: 5-10-85 SH 1 OF REV. A

PART NO.

ITEM	QUANT.	NOMEN/DESCRIPTION		VENDOR	CDR NO.	UNIT COST	TOTAL COST
	16	C1-C7	0.1 uf ceramic Cap.				
		C9-C15,	C18, C23				
	5	C8, C16	1 uf 25v Tant Cap				
		C18, C19, C22					
	3	C17,C18	10 uf 10v Tant Cap				
		C20					
	15	R1-R15	33 OHM Resistor $\frac{1}{4}$W				
	2	R16,R17	4.7K OHM Resistor $\frac{1}{4}$W				
	8	U1-U8	64K Dynamic RAM OHM				
			256K Dynamic RAM				
	8	U9-U16	64K or 256K Dynamic				
			RAM				
	1	U17	74S00				
	1	U18	74LS11				
	1	U19	Prom 6301		C.D.R. 587		
	1	U20	Pal 16L8		C.D.R. 854		
	1	U21	8409-2				
	1	U22	Pal 16R8		C.D.R. 855		
	1	U23	74S32				



GAF Draftrace 250


CDR Systems Inc.
San Diego, California
BATTERY
REV B
ABCD
P1
P2
P3
J1
J4
J5
J6
J7
J8
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
U12
U13
U14
U15
U16
U17
U18
U19
U20
U22
U23
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
C22
D1
D2
X1
Q1
85004A

CDR Systems •

PARTS LIST

DESCRIPTION: Expanded RAM Board

DWG. NO. 85004
DATE: 5-10-85 SH 1 OF REV. A
PART NO.

ITEM	QUANT.	NOMEN/ DESCRIPTION		VENDOR	CDR NO.	UNIT COST	TOTAL COST
	13	C1-C7	0.1 uf Ceramic Capacitor				
		C10-C15					
	4	C8,C9	1 uf 25v Tant. Capacitor				
		C16,C17					
	1	C20	10 uf 10v Tant. Capacitor				
A	1	C18	22 pf Ceramic Cap				
A	1	C19	3-30 Variable Cap				
A	1	R1	200K OHM Resistor ¼W				
A	1	R2	20M OHM Resistor ¼W				
A/B	1	R7	4.7K OHM SIP				
B	2	R5,R6	220/330 OHM SIP 10 Pin				
B	1	R3	220/330 OHM SIP 6 Pin				
A	1	R8	Select on Test				
A	1	R9	Select on Test				
B	1	R4	4.7K OHM Resistor ¼W				
A	1	X1	Crystal 32 KHZ NOM				
A	1	B1	3v Lithium Battery				
A/B	3	D1-D3	1N914 Diode				
	8	U1-U8	64K or 256K Dynamic RAM				
	8	U9-U16	64K or 256K Dynamic RAM				
B	1	U17	74LS373 Latch				
C	1	U18	8254 Timer				
B	1	U19	74LS240 Buffer				
B	1	U20	16L8 Pal		C.D.R. 856		
B	1	U21	8237 DMA Controller				
B	1	U22	5380 SCSI Controller				
			Notes:				
			Items A supplied with clock option				
			B supplied with SCSI option				
			C supplied for extended SCSI option				

CDR Systems •

PARTS LIST

DESCRIPTION:

DWG. NO. 85004

DATE: | SH 2 OF | REV. A

PART NO.

ITEM	QUANT.	NOMEN/DESCRIPTION		VENDOR	CDR NO.	UNIT COST	TOTAL COST
	1		CKT Board		85004		
	1	J1	Dual Row 20 Pin Strap				
	1	P1	20 Pin Dual Socket				
	1	P3	24 Pin Single Row Socket				
	1	P2	11 Pin Single Row Socket				
	1	J5	50 Pin RT Angle Header				
	1	JJ1	Dual Row 4 Pin Strip				
	1	J4	Dual Row 10 Pin Strip				
	16	U1-U16	16 Pin Socket IC				
	3	U17,U19,	20 Pin Socket IC				
		U20					
	1	U22	24 Pin Socket IC				
	2	U21,U23	40 Pin Socket IC				
	2	SR5,SR6	Single Row 10 Pin SIP Socket				
	1	SR3	Single Row 6 Pin SIP Socket				

SMALL COMPUTER SYSTEM INTERFACE

SCSI OPTION FOR RAM 89

CONTENTS

INSTALLATION

THEORY OF OPERATION

NCR 5380 SCSI INTERFACE

ADAPTEC CONTROLLER MANUAL

SCSI INSTALLATION

INTRODUCTION

The Small Computer Systems Interface (SCSI) option is a factory installed option on the C.D.R. RAM 89 Expansion Board (RAM II).

As delivered, the SCSI option is ready to be connected to a hard disc controller typified by the Adaptec ACB-4000. Other controllers may be used, but the normal C.D.R. software is set for the ACB-4000.

With the RAM II board installed in the H/Z89, a 50 pin connector is visible just above the left hand side support bracket on the H/Z89 CPU board. This connector has Pin 1 closest to the CPU board.

Connect a standard 50 pin ribbon cable with an insulation displacement female connector to J5 on the RAM II board making sure that the red or marked edge of the connector is on the Pin 1 side of J5. The ribbon cable (maximum 20 feet) is then connected to the ACB-4000 controller connector on J4. Again make sure that Pin 1 of J4 has the red or marked edge of the ribbon cable near it.

The ribbon cable is easily installed by routing it over both the CPU board and the terminal board in the H/Z89 and feeding it between the hinges on the rear cover. There is usually enough space between the cover and the base of the computer to facilitate this installation method. Many of us take a dim view of modifying the external appearance of the computer, thus the above method is best.

You may, of course, file out the Heath/Zenith 40 pin connector slot on the rear of the computer base and make it a 50 pin connector slot. This would require a 50 pin chassis mount male connector but does make a very professional installation.

SCSI THEORY OF OPERATION

INTRODUCTION

The Small Computer System Interface (SCSI) option is shown on the schematic drawing 85004.

This option is contained on the RAM 89 expansion board and may be configured to allow only use with a hard disc controller. Future software will allow use with the C.D.R. Businet Software. This software will allow coupling up to sixteen SCSI intelligent units. These units can be computers, printers, hard discs, plotters, multiplexers, etc. for a small office local area network.

OPERATION

The PAL at U20 decodes specific I/O for the SCSI chip at U23. This chip is a SCSI interface chip NCR 5380. It drives the SCSI bus at J5 using terminators R3, R5 and R6 for the SCSI bus signals. R4 is used to pull up the End of Process (EOP) signal at Pin 27 of U23.

U21 is used for direct memory access for the Businet Software and is not activated for typical programmed I/O disc control. U18 and U17 are also not activated for programmed I/O.

U19 is used as Identification for Businet with the unit ID defined by jumpers set at JJ1. For normal use, no jumpers are used at JJ1. Connections for unit ID are HEX coded by JJ1 A, B, C, D with the coding set up by A=1, B=2, C=4 and D=8. Thus, the unit can be defined as 0 through 15 by placing jumpers on JJ1. Again the unit for a single user should be set as 0, with no jumpers in place. Gates in U19 are used as buffers for Z80 signals. The Z80 signal "Bus Request" (Pin 25 on P1) is hard wired to +5 volts on some H/Z89-90 computers, thus this pin is a no connect and the output of U19 at Pin 14 is fed only, via Pin 25 on J1, to the RAM 89 main board.

The interrupt output from U23 is fed via Q1 to the NMI input of the Z80 on the RAM 89 main board. This input is not used by the normal SCSI hard disc system and is disabled by the removal of R11.

Generally the software requests for SCSI initialization, drive select, drive formating, drive reading, drive writing and error reporting are all decoded via addresses 90 through 97 HEX by U20 and cause the NCR 5380 at U23 to set up the requested function.

SCSI operates by the initiator (the H/Z89-90) selecting the target (the hard disc drive in this case) and turning over control to the target. The target then requests the initiator to pass the desired command.

Once the target has received the desired commands it proceeds to act upon them, informing the initiator when it has data to transmit or requires another byte of data or other information. The initiator acts upon the request for data from the target and informs the target that all is well via a Request-Acknowledge hand shake. All commands and data transmission follow this hand shake procedure.

All hard disc drives require a controller that is intelligent enough to allow use of the above protocol or variations of the protocol.

The Adaptec ACB-4000 is typical of, and better than, most such controllers.

Information on the Adaptec controller is contained in the Appendix along with further information on SCSI operation.

NCR 5380 SCSI INTERFACE
PRODUCT BRIEF

SCSI INTERFACE

- Asynchronous data transfer to 1.5 MBPS
- Supports both initiator and target roles
- Parity generation w/optional checking
- Supports arbitration
- Direct control of all bus signals
- High current outputs drive SCSI bus directly

MPU INTERFACE

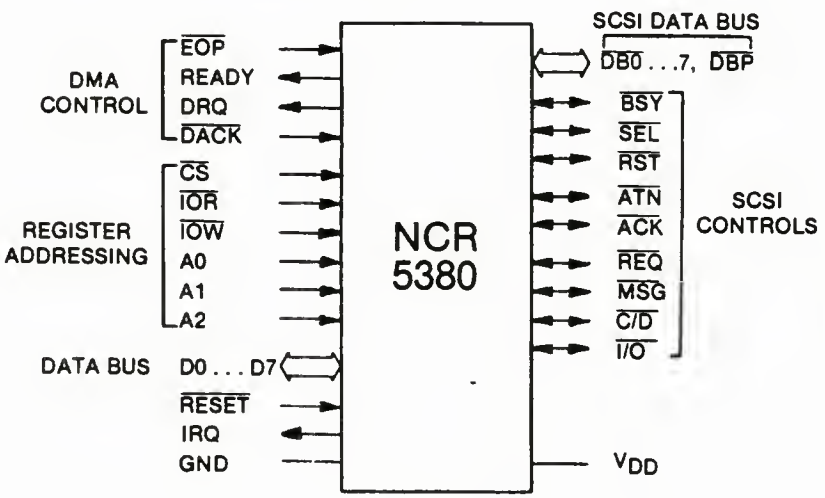
- Memory or I/O mapped interface
- DMA or programmed I/O
- Normal or block mode DMA
- Optional MPU interrupts

The NCR 5380 is designed to accommodate the Small Computer Systems Interface (SCSI) as defined by the ANSI X3T9.2 committee. The 5380 operates in both the Initiator and Target roles and can therefore be used in host adapter and control unit designs. This device supports arbitration, including reselection, and is intended to be used in systems that require either open collector or differential pair transceivers.* It has special high current outputs for driving the SCSI bus directly in the open collector mode.

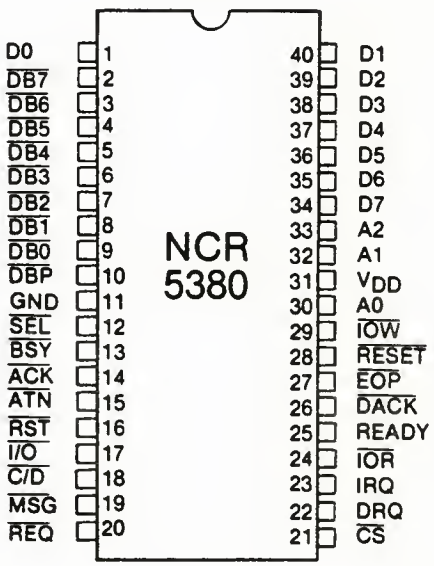
The NCR 5380 communicates with the system microprocessor as a peripheral device. The chip is controlled by reading and writing several internal registers which may be addressed as standard or memory mapped I/O. Minimal processor intervention is required for DMA transfers because the 5380 controls the necessary handshake signals. The NCR 5380 interrupts the MPU when it detects a bus condition that requires attention. Normal and block mode DMA is provided to match many popular DMA controllers.

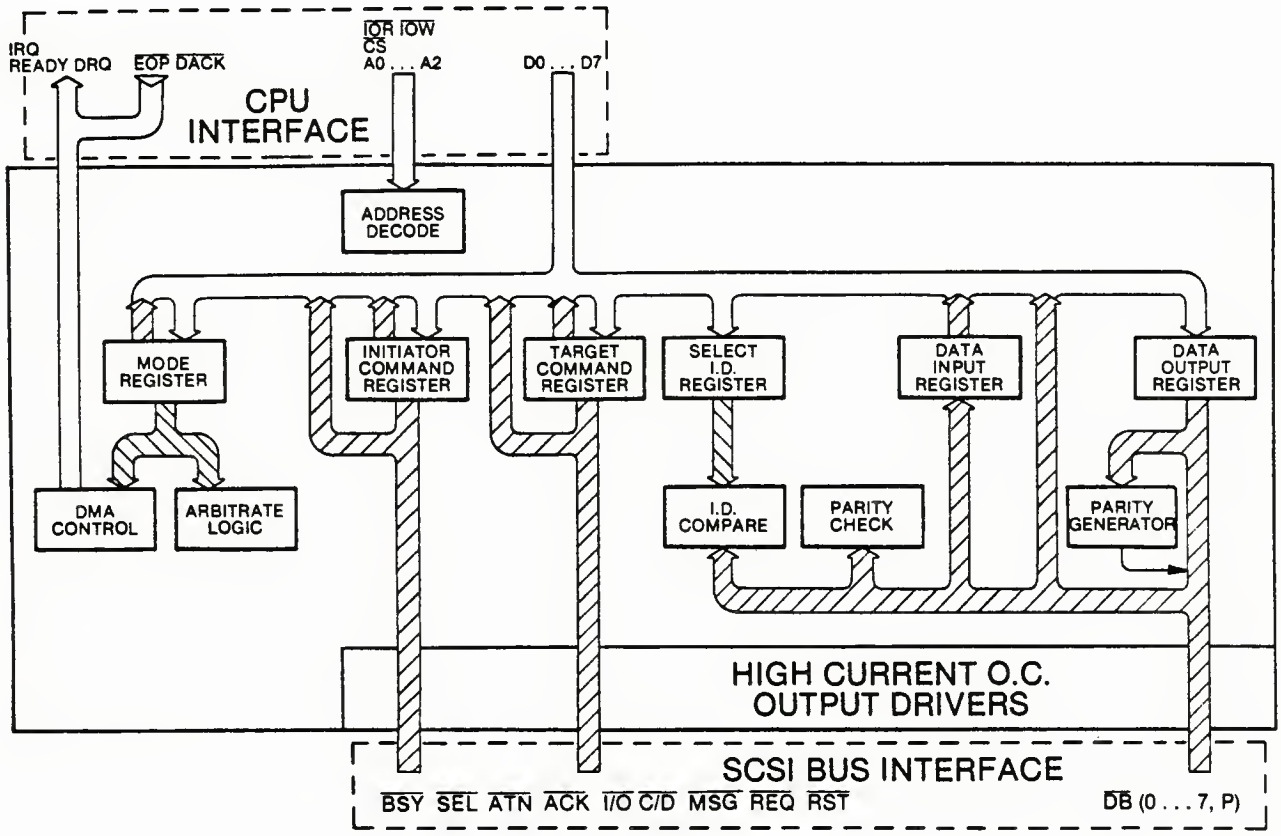
* Differential pair operation is supported in the NCR 5381 (48 PIN).

FUNCTIONAL PIN GROUPING



PINOUT



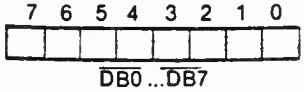


REGISTER SUMMARY

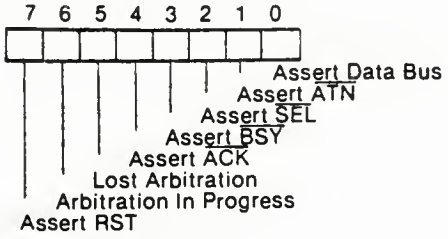
A2	A1	A0	R/W	REGISTER NAME
0	0	0	R	Current SCSI Data
0	0	0	W	Output Data Register
0	0	1	R/W	Initiator Command Reg.
0	1	0	R/W	Mode Register
0	1	1	R/W	Target Command Reg.
1	0	0	R	SCSI Bus Status
1	0	0	W	Select Enable Register
1	0	1	R	Bus & Status Register
1	0	1	W	Start DMA Send
1	1	0	R	Input Data Reg.
1	1	0	W	Start Target Rec. DMA
1	1	1	R	Reset Parity/Interrupts
1	1	1	W	Start Init. Rec. DMA

READ

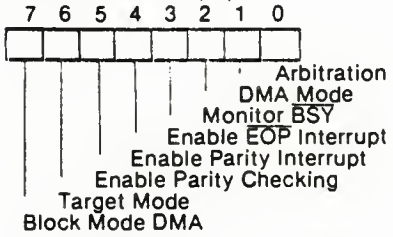
CURRENT SCSI DATA (00)



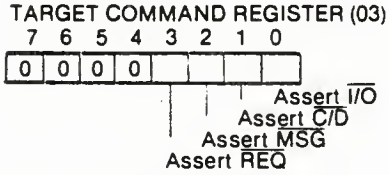
INITIATOR COMMAND REGISTER (01)



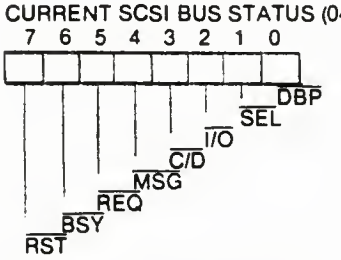
MODE REGISTER (02)



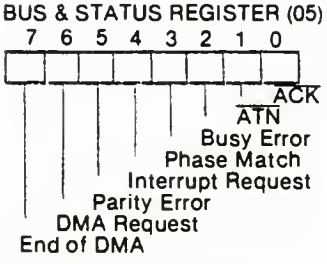
TARGET COMMAND REGISTER (03)



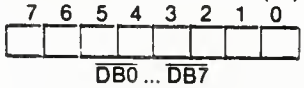
CURRENT SCSI BUS STATUS (04)



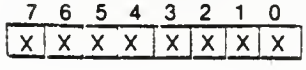
BUS & STATUS REGISTER (05)



INPUT DATA REGISTER (06)

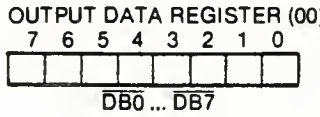


RESET PARITY/INTERRUPT (07)

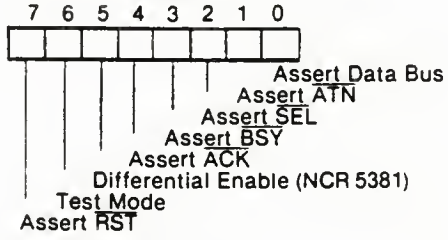


WRITE

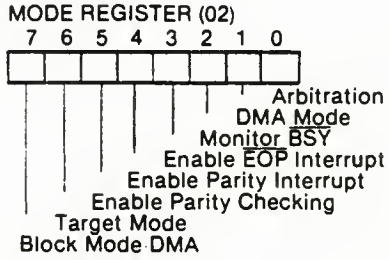
OUTPUT DATA REGISTER (00)



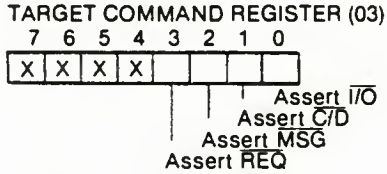
INITIATOR COMMAND REGISTER (01)



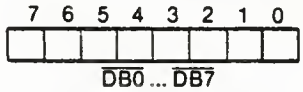
MODE REGISTER (02)



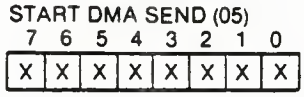
TARGET COMMAND REGISTER (03)



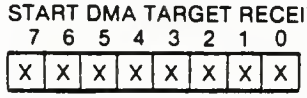
SELECT ENABLE REGISTER (04)



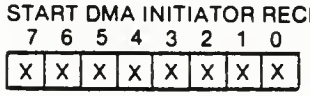
START DMA SEND (05)



START DMA TARGET RECEIVE (06)



START DMA INITIATOR RECEIVE (07)



NOTE: X = DON'T CARE

FEATURES AND SPECIFICATIONS FOR ADAPTEC ACB-4000

CONTROLLER BOARDS

Applications	Single-User Systems, e.g. Word Processing, Personal Computers
Host Interface	SCSI/SASI
Drive Interface	ST506/ST412
Key Features	*High Performance --Read/Write Without Interleaving --Dual-Ported FIFO Buffer --Fully Transparent Defect Skipping at the Sector Level --Error Detection/Correction (32-bit ECC) --High Speed Data Search --16 Head Support --High Speed Seek Pulses *Auto Configure --Easy Upgrade and Modification with Drives --Complete Device Independence *Ease of use --One Pass Rapid Formatting --Logical Block Addressing --Variable Block Size (256, 512 or 1024) --Multiple Block Data Transfer (up to 64K blocks) --Implied Seek *Versatility --Multiple Controllers/Channel --Multiple Hosts/Channel --Five Megabits/Second Disk Transfer Rate
Physical Dimensions	Width 5.75 inches Length 7.75 inches Height .5 inches Weight 1 pound